Technology for

# Alaskan Transportation

Summer - Volume 17 Number 2
Alaska Transportation Technology Transfer Program

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"Improving Alaska's quality of transportation through innovative technology."

ALASKA TRANSPORTATION TECHNOLOGY TRANSFER

This newsletter is funded by a grant from the Federal Highway Administration and the Alaska Department of Transportation and Public Facilities.

## Repair of Asphalt Pavements

**(Second of a three-part series)**

Pavement managers probably have a record of the type and severity of distresses present in their pavements, whether it is recorded in their minds for a small highway system or in an elaborate data base for a large highway system. It is not only important to be able to accurately identify particular distresses, it is also important to know the causes of the distresses so that an effective repair can be prescribed. For example, in the first article of this series in the October Eclectic, it was shown how an inadequate repair resulting from the improper diagnosis of the cause of distress resulted in a shortened service life. Also, it was shown how performance curves can be used to make better decisions regarding the timeliness of repairs. The types and causes of typical distresses of asphalt pavements and the methods of repair will be discussed in the present article.

### Types and Causes of Distresses

### Cracking

The basic types of cracks are longitudinal, transverse, alligator, reflection, and edge. Longitudinal cracks can result from construction practices such as using cold construction joints but usually are caused by the loads imposed by traffic. Transverse cracks are usually the result of shrinkage of one of the pavement layers, which may be caused by temperature or moisture changes. Alligator cracks, named for the crack pattern that

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## New Model Designed for Asphalt Chemistry

The National Research Council's Strategic Highway Research Program (SHRP) is conducting research on asphalt chemistry that has changed basic understanding of asphalt properties. This new knowledge will allow highway engineers to design pavement structures that take full advantage of asphalt's chemical and physical properties, and it will make it easier to build pavements to last longer.

Asphalt is about 90 percent carbon and hydrogen; the remaining 10 percent is sulphur, nitrogen, oxygen and trace metals. These elements attach themselves to the hydrocarbon molecules in side groups referred to as "polar functional groups." These groups determine whether the asphalt molecules will "stick together" by forming networks that give the asphalt strength, while still allowing it to flow like a viscous liquid.

Using advanced chemical analysis techniques, combined with exhaustive examination of asphalt properties, researchers have learned about a specific chemical component that is very influential in asphalt performance: amphoterics. An amphoteric material is one that is both an acid and

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## Use Recycled Paper

Using recycled paper products is encouraged. By encouraging a market for recycled products, prices on such goods will decrease and more people will voluntarily contribute to better environmental conservation.

The following suggestions can help offices minimize paper waste:

- Use recycled copying paper and request that materials be printed on recycled paper
- Copy on both sides of paper
- Use white rather than colored paper. Although bleached, white paper is still easier to recycle than colored paper
- Use smaller print or font for typed material
- Turn used paper into memos or recycle it
- Reuse envelopes, folders and boxes
- Request recycled paper products

## CONEXPO '93

The International Construction Equipment Exposition will be held from March 20-25, 1993 in Las Vegas, Nevada. The Expo features over one million square feet of exhibit space, the latest in construction equipment, parts, components, technologies and services. There will also be on-site demonstrations and seminars. Beat the registration lines by calling toll-free 1-800-366-1364 or by FAX 1-800-676-8004. Or you can complete the Official Advance Registration Form (we have one at the $T^2$ office) and send it to:

**CONEXPO '93**
**Registration Headquarters**
**P.O.Box 31408**
**Raleigh, NC 27622-1408**

We also have a listing of the seminars, schedule and travel info at our $T^2$ office.

**New Model Designed for Asphalt Chemistry**
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a base in the same molecule. They appear to exert major control over the formation of molecular matrices, which in turn affects the asphalt's tendency to form pavement cracks, ruts, and potholes.

If the network is not strong enough, the asphalt will not be sufficiently elastic —it won't "spring back," and thus will be prone to rutting. If the network is too strong, the pavement will not give and will be prone to fatigue cracking. Moisture sensitivity (which can lead to cracks, potholes, and other forms of pavement deterioration) also is a function of the network because it is the polar molecules that cause the asphalt to adhere to the aggregate, and it is this bond that breaks down in the pavements suffering the moisture-induced damage.

SHRP is developing new tests that manufacturers can use to determine the chemical and physical properties of asphalt cement and to modify it to give better performance. Another series of tests is being developed for use by highway agencies so they can select asphalt cements and aggregates that will give the best performance. New performance-based specifications for both asphalt binders and mixtures are based on these tests.

*Reprinted from the Rural Technical Assistance Program Quarterly Newsletter, March, 1992.*

# News & Views

## Conference Announcement

Having a hard time with cold and dark winters lately? Feeling caught and stuffed in that old office grind? Then here's your big chance to get out and attend the Third International Conference on Managing Pavements at the Hyatt Regency in San Antonio, Texas, May 21-26, 1994.

The real objective of the conference is to enhance the effectiveness and efficiency of managing pavements for roads, streets, airfields and other areas. The conference will provide an opportunity for executives, practitioners, and researchers to share and evaluate recent experience with pavement management systems. It will address the benefits of implementation, the effects of support to decision-making, advances in the state-of-the-art and technology, and the need for future development.

Those of you with the gift of written gab who would like to present a paper at the conference should send in a synopsis of 400-600 words describing the scope, findings and status of the work, and identifying the theme under which the paper should be considered.

Please send it to the following address:

Attn: Frank R. McCullagh
Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

But don't wait! The deadline for the synopsis is Oct. 15, 1992. Good luck and don't forget the suntan lotion.

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## ATSSA Receives FHWA Safety Excellence Award

The American Traffic Safety Services Association (ATSSA) and the SASHTO Regional Test Facility were awarded the Federal Highway Administration's first Safety Excellence Awards.

ATSSA received the award specifically for significant contributions in working with the SASHTO Test Facility and for promoting work zone safety through its comprehensive work zone safety training program.

The SASHTO Regional Test Facility received the award for establishing a facility for testing pavement marking and signing materials and other traffic control devices.

ATSSA sponsors worksite supervisors' training in Anchorage, Juneau and Fairbanks in March and April. Many government and private construction and maintenance workers in Alaska have received ATSSA certification.

resembles alligator skin, are caused by traffic loadings that cause excessive movement and result in fatigue failure of the asphalt layers. Basic causes of load-associated cracking are excessive moisture in the pavement system, resilient subgrades, or weak pavement layers. Also, the surface course may be too brittle to withstand normal deflections. Reflection cracks are caused by existing cracks in the underlying layer, and edge cracks result from lack of support on the outside edge of the pavement.

## Rutting, Pushing, or Shoving, and Slippage Failures

Although rutting and pushing or shoving are visibly different, they are discussed together because the underlying causes are similar. Rutting appears as longitudinal, parallel depressions in the wheel paths, and shoving or pushing often appears as washboard-like transverse parallel depressions, which often occur at intersections prior to traffic lights. Both of these distresses are caused primarily by shear failure of one or more of the pavement layers.

Slippage failures are characterized by large crescent-shaped cracks in the surface layer, which point in the direction of the movement of the traffic loads. They can be caused by asphalt mixtures with weak tensile strength, but they usually result from a lack of good bond between the distressed layer and the underlying layer.

## Patching

Patching is not a type of distress but is evidence of the prior need of temporary pavement repairs resulting from a severe distress. Patching may indicate the previous existence of potholes, alligator cracking, localized pushing, or severe raveling. Usually, the type of distress that was responsible for the repair is evident in adjacent areas in a moderate form.

## Surface Defects

Surface defects include an asphalt-rich surface (bleeding), polished aggregate, which affects friction resistance, or disintegration of the surface known as raveling. Bleeding is attributed to faulty asphalt mix design; aggregate polishing is the result of using a poor quality aggregate; and raveling results from a lack of adhesion between the asphalt and aggregate or severe embrittlement of the asphalt-fines matrix.

## Typical Repairs

### Load-Associated Distresses

Load-associated distresses that have already been discussed include longitudinal and alligator cracking, rutting, shoving, and slippage. Longitudinal and alligator cracking indicate a structural deficiency that must be corrected by increasing the strength of the pavement, usually by the application of an overlay. Localized failures resulting from wet or weak subgrade and bases must be repaired by correcting the origin of the problem and not with a cosmetic face-lift. If base or intermediate layers of asphalt are severely deteriorated because of stripping (asphalt moisture damage), the damaged layers may have to be removed in order to accomplish a successful repair.

Rutting or shoving failures are load-associated failures caused by one or more pavement layers that are weak in shear strength. Washboard type failures are usually associated with the asphalt layers near the surface. Although it is possible to bridge the weak layer in isolated instances, it is wise to remove the layer that is causing the problem so that the same type of failure will not reoccur after an overlay is applied. Also, if a deformed asphalt surface is not removed before an overlay is applied, it is impossible to get uniform density in the new surface. If the traffic loading is very severe, it may be a good idea to consider a special asphalt mix design to provide maximum shear resistance. Large-aggregate mixtures and special additives—such as polymers, fibers, and stiffening agents—have been effective. Another simple operation for small jobs is to lower the asphalt content slightly at problem locations such as intersections.

Slippage failures can be prevented by ensuring a good bond between the overlay and the underlying layer. The correct amount of tack coat before paving and a rough-milled surface should promote good bond. The failed pavement should be removed before an overlay is applied.

Although it is difficult to remedy edge cracking, it can be minimized by increasing shoulder support and channeling the traffic away from the edge of the pavement when possible.

### Distresses not Associated with Loads

Transverse and construction joint cracks need not be sealed unless the water that enters will weaken the underlying layers. Surface defects can be corrected with a surface treatment such as chip seal or slurry seal. These treatments also may be effective in correcting slick surfaces. Another alternative repair to correct a slick surface is to apply a good, thin friction-developing overlay. If the surface is very rich in asphalt, it may be necessary to remove the asphalt-rich surface before the new seal or overlay is applied to prevent the asphalt from bleeding through the new surface. Some research is presently being conducted on the use of large aggregate in chip seals to prevent asphalt from bleeding through.

## Pavement Investigation and Design

When the types of distresses indicate that the failure is load-associated, i.e., the traffic loading is too heavy for the present structure, it is necessary to strengthen the pavement by adding an overlay or possibly strengthening the existing layers. A survey with deflection-type equipment such as a falling-weight deflectometer or Dynaflect can indicate how much overlay is required and possibly identify the particular layer that is weak. It may be advisable to remove pavement cores and samples to identify the extent of excessive moisture, stripping, and rutting and shoving failures. Any investigation should be conducted in a systematic manner with enough samples to reach valid conclusions.

There are many design methods that are available to compute the thickness of an overlay. The Asphalt Institute details a method in its MS-17 manual, which is also available on a computer disk.

## Next Time

In the next Eclectic, the last article of this series will cover how economic analysis should be used to compare the various alternatives that may be available to you.

For further information, please contact Bill Maupin at (804) 293-1948 or SCATS 745-1948.

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"Work smarter, not harder."

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